Internal Medicine
The Japanese Society of Internal Medicine
doi: 10.2169/internalmedicine.9663-17
Intern Med 57: 1105-1109, 2018
http://internmed.jp

【 CASE REPORT 】

Successful Treatment of Mitral Regurgitation after Transapical Transcatheter Aortic Valve Implantation by Percutaneous Edge-to-edge Mitral Valve Repair (MitraClip®) —The First Combination Therapy Performed in Japan—

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Abstract:
A 75-year old man with a history of inferior myocardial infarction was admitted with symptoms of progressive heart failure 3 months after undergoing transapical transcatheter aortic valve implantation (TAVI). Echocardiography revealed severe mitral regurgitation (MR) caused by posterior leaflet tethering, without traumatic injury of the mitral valve or chordae. The patient was successfully treated by percutaneous edge-to-edge mitral valve repair (MitraClip®). This case highlights the role of MitraClip® in high-risk patients suffering from MR, and suggests that apical contractile loss or adhesion caused by apical puncture and suturing in transapical TAVI may be one of the mechanisms of worsening MR.

Key words: percutaneous edge-to-edge mitral valve repair, MitraClip, mitral regurgitation, tethering, transcatheter aortic valve implantation, TAVI

(Intern Med 57: 1105-1109, 2018)
(DOI: 10.2169/internalmedicine.9663-17)

Introduction

Transcatheter aortic valve implantation (TAVI) has become an alternative treatment for high risk aortic stenosis (1). Hybrid therapies, including TAVI for aortic stenosis with concomitant coronary artery disease or other valvular abnormalities, have recently emerged as a new option for high risk patients (2). We herein report the first Japanese case of percutaneous edge-to-edge mitral valve repair using a MitraClip® (Abbott Vascular, Santa Clara, USA) in a patient with worsening mitral regurgitation (MR) after TAVI.

Case Report

A 75-year-old man was admitted to our institution with symptomatic aortic stenosis. His past medical history included prior inferior myocardial infarction, coronary artery bypass surgery, renal artery stenosis, and grade 4 chronic kidney disease. Echocardiography showed severe aortic stenosis (aortic valve area, 0.82 cm^2; mean transvalvular gradient, 45 mmHg); left ventricular (LV) ejection fraction, 53%; LV end-diastolic dimension (Dd)/end-systolic dimension (Ds), 58/44 mm, with a hypokinetic area on the LV basal inferior wall, and grade 2+ MR due to posterior leaflet

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Received: June 13, 2017; Accepted: August 16, 2017; Advance Publication by J-STAGE: December 21, 2017
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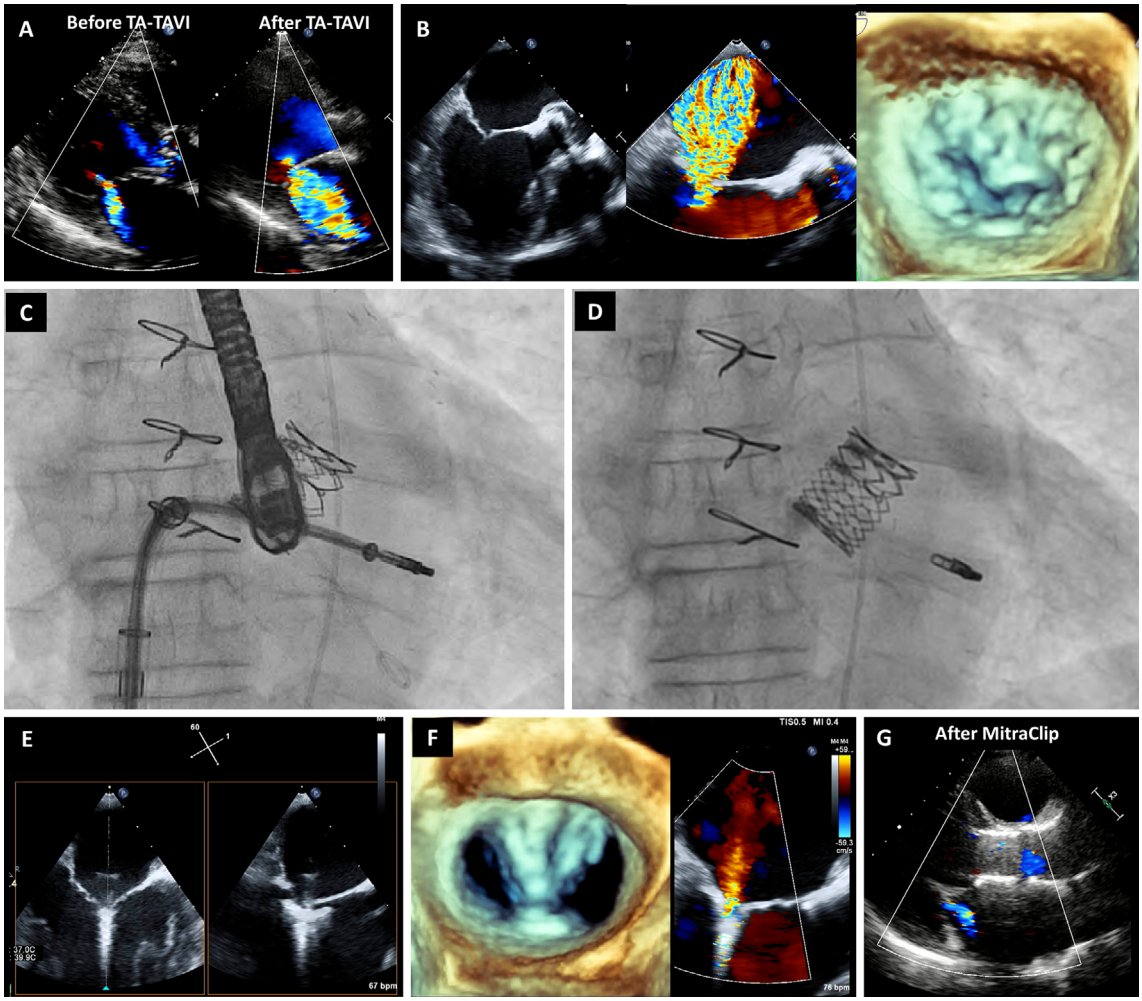

Figure 1. **(A) Transthoracic echocardiography showed the worsening of mitral regurgitation after transapical transcatheter aortic valve implantation (TA-TAVI). (B) Transesophageal echocardiography showed decreased coaptation of the mitral valve without leaflet prolapse or chordal rupture. (C-E) A MitraClip® system was delivered via the right femoral vein by a transseptal approach and was successfully deployed. (F-G) 3D and color Doppler echocardiography after MitraClip® deployment. Mitral regurgitation was successfully reduced to grade 1+.**

tethering with mitral annular diameter of 40 mm. Enhanced computed tomography confirmed the patency of the bypass grafts and revealed an abdominal aortic aneurysm of 38 mm in diameter with aortic plaques. Given the high risk of operative mortality [Society of Thoracic Surgeons-Predicted Risk Of Mortality (STS-PROM) score, 10.6%; European System for Cardiac Operative Risk Evaluation II (EuroSCORE II), 10.8%] and aortic anatomy, our heart team decided that transapical TAVI (TA-TAVI) was indicated.

TA-TAVI was performed via left minithoracotomy in the 5th intercostal space, with a 29-mm SAPIEN XT valve using the Ascendra+ system (Edwards Lifesciences, Irvine, USA). Intraoperative monitoring by transesophageal echocardiography detected mild paravalvular aortic regurgitation, but there was no acute MR or traumatic exacerbation. His postoperative course was uneventful. However, echocardiography at 1 week after TAVI revealed that the MR had worsened to grade 3+ with no obvious change in the LV function (ejection fraction, 52%; Dd/Ds, 57/45 mm).

Three months later, he was readmitted with symptoms of progressive heart failure with new-onset atrial fibrillation. Echocardiography revealed grade 4+ MR (Fig. 1A) and LV dysfunction (ejection fraction, 35%; Dd/Ds, 60/50 mm). A further analysis by transesophageal echocardiography showed the worsening of the posterior leaflet tethering (tenting height, 9.9 mm; tenting area, 1.49 cm^2) without mitral valve prolapse or chordal rupture (Fig. 1B). Non-contrast cardiac magnetic resonance imaging was performed to assess the LV dysfunction, which revealed adhesion of the LV apical area by tagged cine magnetic resonance imaging (Fig. 2A). The assessment of the myocardial substrate by native T1 mapping suggested diffuse myocardial fibrosis and localized thinning of the LV apex in color maps of the native T1 values (Fig. 2B).

Our heart team discussed the surgical indications for symptomatic MR and the indications for percutaneous edge-to-edge mitral valve repair using a MitraClip®, and the eligibility committee confirmed that the patient was eligible for

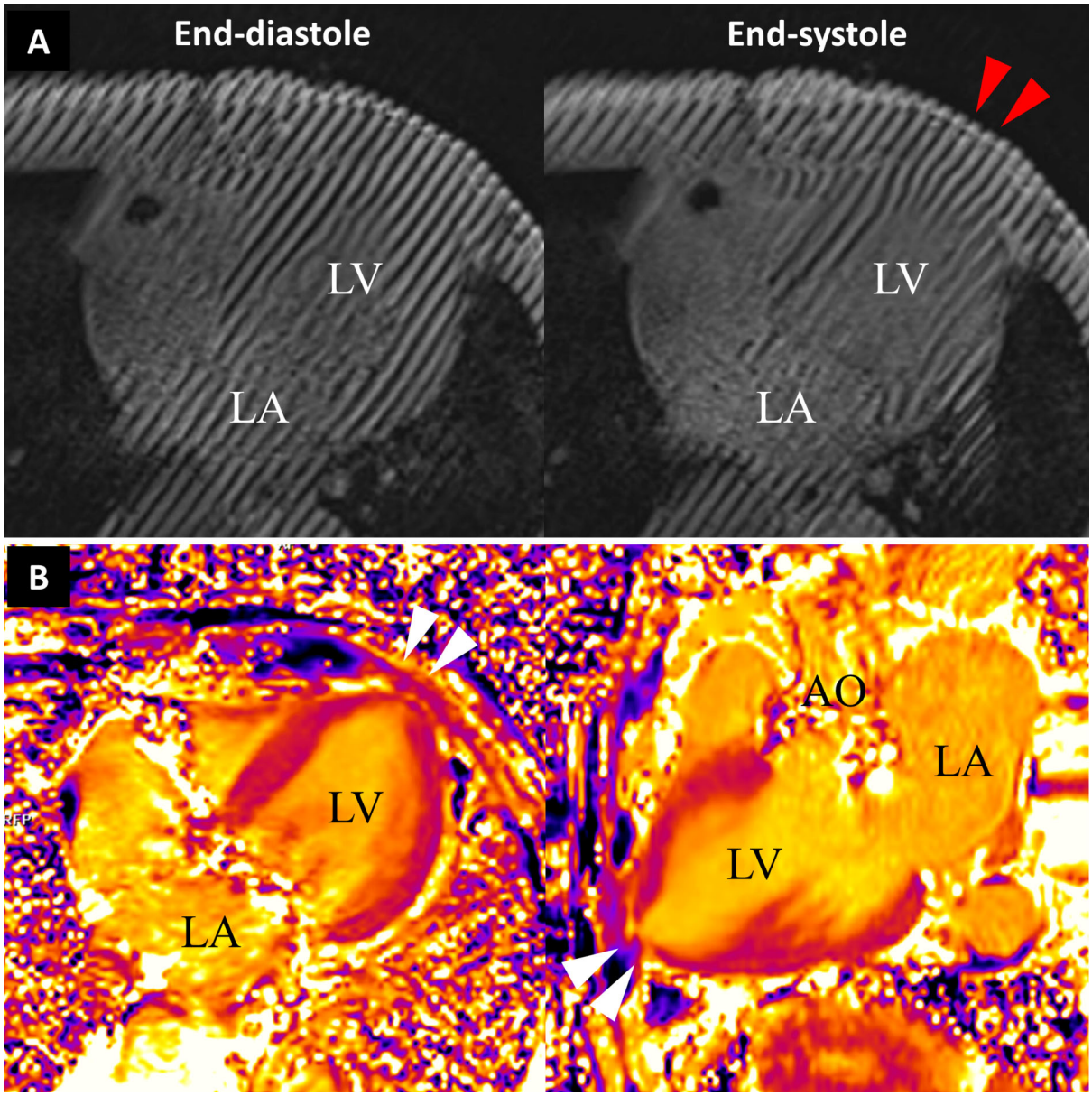

Figure 2. **Non-contrast cardiac magnetic resonance images obtained after transapical transcatheter aortic valve implantation. (A) Tagged cine magnetic resonance images suggested adhesion of the left ventricular apical area (red arrowheads). (B) Color maps of the native T1 values demonstrated the localized thinning of the apex (white arrowheads). AO: aorta, LA: left atrium, LV: left ventricle**

inclusion in the AVJ-514 Japan trial (ClinicalTrials.gov NCT 02520310) (3). As previously described (3, 4), the MitraClip® system was introduced via the right femoral vein and delivered through a transseptal approach (Fig. 1C-E). MR was successfully reduced to grade 1+ after the application of the first clip, which grasped the middle of A2/P2 (Fig. 1F-G). The procedure was successfully completed, and the rest of his hospitalization was uneventful. After 12 months of follow up, he remained minimally asymptomatic (New York Heart Association functional class I) without any recurrence of significant MR or atrial fibrillation (ejection fraction, 47%; Dd/Ds, 60/45 mm; Fig. 3).

Discussion

We reported the case of a patient with pre-existing mitral tethering whose MR worsened after TA-TAVI. The patient was successfully treated by percutaneous edge-to-edge mitral valve repair using a MitraClip®.

Previous reports have described improvements of coexisting MR in the majority of patients after TAVI, as a reduction of the LV pressure, LV reverse remodeling, and the improvement of mitral leaflet tethering have been suggested to contribute to a reduction of MR (5-10). Nevertheless, worsening of MR is reported in approximately 3-10% of cases (5, 6, 11, 12).

Dilation of the mitral annulus (>35.5 mm)-which was ob-

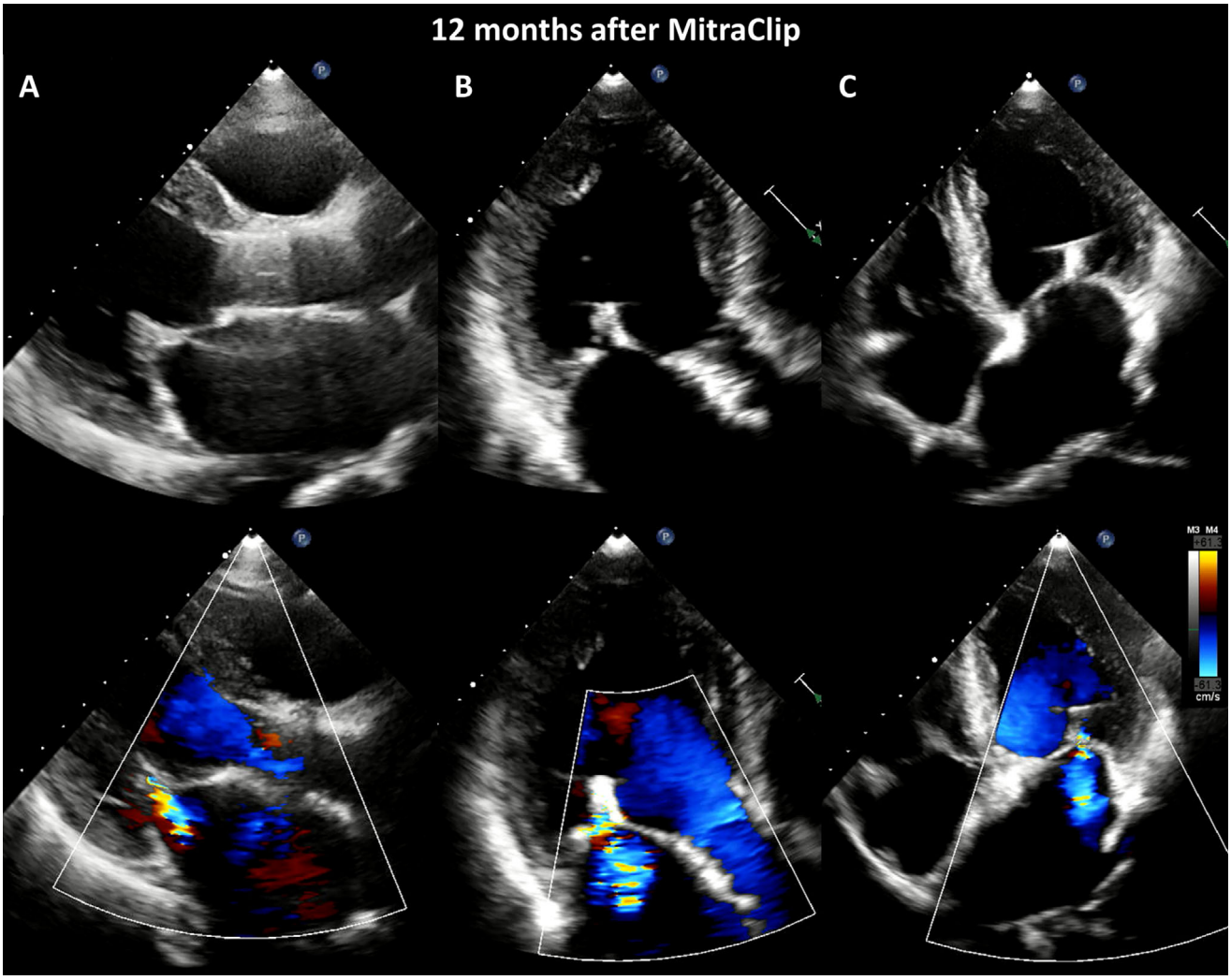

Figure 3. **Transthoracic echocardiography and color Doppler echocardiography [(A) parasternal long axis view, (B) apical three-chamber view, (C) apical four-chamber view] at 12 months after MitraClip® deployment. No significant recurrence of mitral regurgitation was observed (grade 1+).**

served in our patient-and mitral calcification have been reported to predict persistent MR after TAVI (12). However, the mechanisms of persistent or worsening MR after TAVI have not been fully elucidated. Traumatic injury of the mitral leaflet or mitral chordae, impingement of the anterior mitral leaflet by an aortic prosthesis, or mechanical dyssynchrony due to new left bundle branch block have previously been suggested as possible mechanisms (13, 14). In our case, no traumatic injury of the mitral apparatus or mitral impingement was noted on echocardiography, and no left bundle branch block was noted on electrocardiography. However, transesophageal echocardiography revealed worsening MR from decreased mitral valve coaptation due to worsened posterior tethering. Furthermore, LV apical contractile loss and apical adhesion (revealed by cardiac magnetic resonance imaging), which results in decreased longitudinal contraction or loss of apical torsion (15-18), might have led to a worsening of the posterior leaflet tethering and decreased mitral valve coaptation.

While this case highlights the role of percutaneous edge-to-edge mitral valve repair in high-risk patients suffering from MR after TAVI, apical puncture and suturing in TA-TAVI may be mechanisms of worsening tethering and worsening MR in patients with pre-existing MR due to leaflet tethering.

Author's disclosure of potential Conflicts of Interest (COI).
Satoshi Yasuda: Research funding, Abbott Vascular.

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